FABRICATION OF BONE SCAFFOLDS FROM ANADARA GRANOSA SHELL WASTE

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Abstract:
Bone defect and irregularities may cause by traumatic injuries or pathological condition such as osteoporosis and bone cancer [1-3]. In today's medical practices, traditional treatment methods like autograft and allograft are still being used to treat the bone defect. However, these methods have some drawbacks such as insufficient bone donations, threat of donor-site morbidity and risk of disease transmission [4-6]. Currently, biomaterial scaffold has been widely explored to treat the defect where it serves as template for bone regeneration. On the other hand, the shell waste of Anadara granosa or known as cockle is biomaterial that are made up of more than 95% of calcium carbonate (CaCO3) and could have potential in bone engineering applications. Recent studies show that CaCO3 from molluscan shell has good osteoconductivity which can stimulate bone cell differentiation, induce bone formation and used as bone filling material [7, 8]. Thus, the aim of this study is to investigate the effect of cockle shell powder concentrations on physicochemical properties and bioactivity of the bone scaffold. The cockle shell powder were mixed with sodium alginate (SA) gel solution at ambient environment and lyophilized to obtained three dimensional bone scaffolds. The scaffolds were then physicochemically characterized using XRD, FTIR, SEM, EDX, universal testing machine, porosity and swelling percentage while its bioactivity were assessed using simulated body fluid (SBF) solution. As shown in XRD patterns (Fig. 1), the scaffolds that contained cockle shell powder has distinguished CaCO3 peak in the form of aragonite crystal. This indicates that the properties of the scaffold remain as CaCO3 which can be functional as biomaterial for bone applications. Previous studies done by Bharatham et al. [9] and Mahmood et al. [10] also reported parallel results. Subsequently, the comparison of scaffold morphologies containing 0%, 20% and 80% of cockle shell powder are shown in Fig. 2. The higher concentration of deposited cockle shell powder on the surface of sodium alginate network, the denser the scaffold morphology. This finding is aligned with our previous work where denser scaffolds have higher compressive strength [11]. Similar trends were also reported in Morsy et al. [12] as well as Chang and Zhang [13]. Additionally, EDX analyses show the presence of calcium element in the scaffolds containing cockle shell powder (Fig. 2(b) and 2(c)). This result can be correlated with XRD results in Fig. 1 where CaCO3 is the main element in the cockle shell powder. Overall, the addition of cockle shell powder into bone scaffold have improved the physicochemical properties and bioactivity of the scaffold.

Keywords: *Bone scaffold; calcium carbonate; cockle shell waste; freeze dry*